A Conceptual Framework Proposal for a New Geometric Structure Based on Eigenvalue Hierarchy

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Abstract

This paper proposes a novel mathematical and physical conceptual framework to explore the linkage between microscopic eigenvalue hierarchies and macroscopic spacetime representations. Inspired by David Bohm's Implicate Order and Holomovement, we define a mapping from the initial wavefunction Ψ(0) to a structural lattice matrix G6 via the mapping operator M^. Introduced as an axiomatic ansatz, G6 satisfies Tr(G6)=6 and yields precise analytical eigenvalues λ=2,2±2. Furthermore, we outline a qualitative matrix expansion model (S7→S8→S9) via the topological operator D, and present an incomplete hypothesis connecting these configurations to the lepton mass hierarchy through exponential scaling with topological dimensional weights. Finally, the global unitary loop is established as an axiomatic request for spatial closure, supplemented by Python concept visualization demos illustrating the theoretical dynamics of the framework.

Keywords: Conceptual Framework, Lattice Matrix, Eigenvalue Hierarchy, Unitary Postulate, Concept Visualization Demo

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1. Introduction

While modern standard cosmology (ΛCDM) and quantum field theory have successfully described macroscopic spacetime and microscopic probabilistic structures, respectively, their fundamental integration remains an unsolved challenge. This study proposes a new conceptual framework exploring the possibility that macroscopic spacetime and microscopic particle information may emerge simultaneously from the eigenvalue hierarchy of an algebraic matrix structure.

This spatial lattice mapping is inspired by David Bohm’s concept of "Implicate Order," while conceptually drawing from the cosmological perspective of the *Cheonbugyeong* (□□□), a traditional Eastern philosophy. The intuition from *Cheonbugyeong* serves as a key motivation for the mathematical ideas presented here.

Declaration of Structural Separation: To maintain academic objectivity and rigor, the philosophical intuition of the *Cheonbugyeong* is confined to the interpretive background in Chapter 1. The mathematical physical mechanism to formalize this is developed based on the axioms and definitions in Chapter 3, strictly separating philosophical inspiration from mathematical algebraic structure.

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2. Theoretical Background

- **David Bohm’s Holomovement:** Formalizes the ontology that all things exist in a continuous flow of "enfoldment" and "unfoldment" through the cyclicity of a mathematical lattice.
- **Von Neumann Measurement Theory (Projection Operator P^n=|n⟩⟨n|):** Extends the standard formulation of state collapse to serve as the conceptual basis for the mapping operator M^.
- **Robertson-Schrödinger Uncertainty Relation:** Uses the lower bound of variance for non-commuting operator pairs as the necessity for geometric boundary conditions.

- **Atiyah-Singer Index Theorem:** Referenced as a conceptual analogy. Inspired by the correspondence between the analytic properties of differential equation solutions and the topological structure of space, it explains how macroscopic information divergence interacts with and cancels/preserves within a global topological loop.

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3. Proposed Model and Mathematical Setup

3.1 Mathematical Nature and Role of Operator M^

We define Ψ(0) as the initial pure state—an undifferentiated potential wavefunction—in an abstract Hilbert space H. The mapping M^:H→M3(R) is defined as a Measurement & Mapping Operator that mediates observer effects and the "Grand Triad" (□□□) action to derive the lattice matrix G6 with fixed eigenvalues and a trace.

3.2 The Lattice Matrix G6 (Ansatz) and Geometric Properties

G6 is not derived from existing Lagrangian physics but is an axiomatic ansatz introduced to satisfy the cosmic geometric master equation:

$$M^\Psi(0)=G6=101020103$$

G6 possesses the following distinct geometric properties:

1. **Diagonal and Trace (Tr(G6)=6):** The sum of the diagonal components is exactly 1+2+3=6, representing the algebraic foundation of the minimum physical energy of the hexagonal field lattice.
2. **Symmetry of Off-Diagonal Components (G13=G31=1):** G6 is a symmetric matrix (G6=G6T), serving as an algebraic boundary condition to prevent energy loss when spacetime information is retrieved into the initial state.
3. **Precise Eigenvalues:** Solving the characteristic equation det(G6−λI)=0 yields:

   $$\lambda1=2-2\approx0.5858,\lambda2=2,\lambda3=2+2\approx3.4142$$

3.3 Topological Lattice Operator and Spacetime Matrix Expansion

The discrete lattice defined in 3×3 real matrix space expands into a macroscopic representation via the dimension expansion operator D:

$$DG6=S7\rightarrow S8\rightarrow S9$$

- **S7 (Connection Dimension):** Formation of geometric topological networks (Weight d1=7).
- **S8 (Spatial Dimension):** Construction of 3D geometric frameworks (Weight d2=8).
- **S9 (Spacetime Completion):** Expansion phase where time-axes and spatial curvature integrate (Weight d3=9).

3.4 Integrated Cyclic Master Equation and Spatial Unitarity

The master equation encompassing the entire process of cosmic generation and expansion is:

∯UniverseD[M^Ψ(0)]=S7,8,9

The global retrieval formula, employing the form of Gauss's Divergence Theorem, is:

∫Matrix∇·S9dV=Ψclosed(0)

The condition that the cycle closes stably is an **Axiomatic Postulate** required by the master equation to guarantee the completeness of the system, not a numerical approximation.

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4. Correspondence Limits and Hypothesis

- **4.1 Macroscopic Limit and General Relativity:** We explore the mapping of microscopic G6 to the macroscopic metric tensor gμν via a deformation tensor field Jaμ(x).
- **4.2 Lepton Mass Hierarchy Hypothesis:** We propose a non-linear exponential scaling formula:

  mi=m0exp(Bdiλi2−α)

- **4.3 Gauge Symmetry:** The 3-stage Holomovement structure is explored as an algebraic representation potentially isomorphic to U(1)×SU(2)×SU(3) gauge symmetries.

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5. Concept Visualization Demos

(Attached Python source codes serve to intuitively demonstrate the dynamical mechanisms of the 2-stage dimensional expansion and 3-stage unitary retrieval, rather than acting as numerical verification tools.)

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6. Limitations and Future Research Roadmap

This framework is currently in the early-stage of mathematical modeling.

- **Task 1:** Derivation of G6 from First Principles (Lie Algebra/Graph Theory).
- **Task 2:** Dynamic integration with the Einstein-Hilbert Action.

- **Task 3:** Verification of Algebraic Isomorphism with Gauge Groups.
- **Task 4:** Yukawa Coupling matching and experimental falsifiability.

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7. Conclusion

This cosmic geometric cycle framework proposes a new paradigm for the continuum linkage between lattice algebraic structures and macroscopic spacetime. While the absence of a first-principles derivation of G6 and the lack of a formal action principle remain limitations, the roadmap outlined here transforms this from a philosophical metaphor into a candidate preprint for academic discourse.

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- **Copyright Registration:** Korea Copyright Commission, No. 2026-038804.
- **Patent Applications:**
    1. "MHD-optimized Eigenvalue Hierarchy Matrix and Zero-frequency Offset Feedback System for Fusion Reactors" (No. 10-2026-0129428).
    2. "Eigenvalue Hierarchy-based Quantum Control System and Zero-frequency Offset (ZFO) Quantum Coherence Maintenance Device" (No. 10-2026-0129428).
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